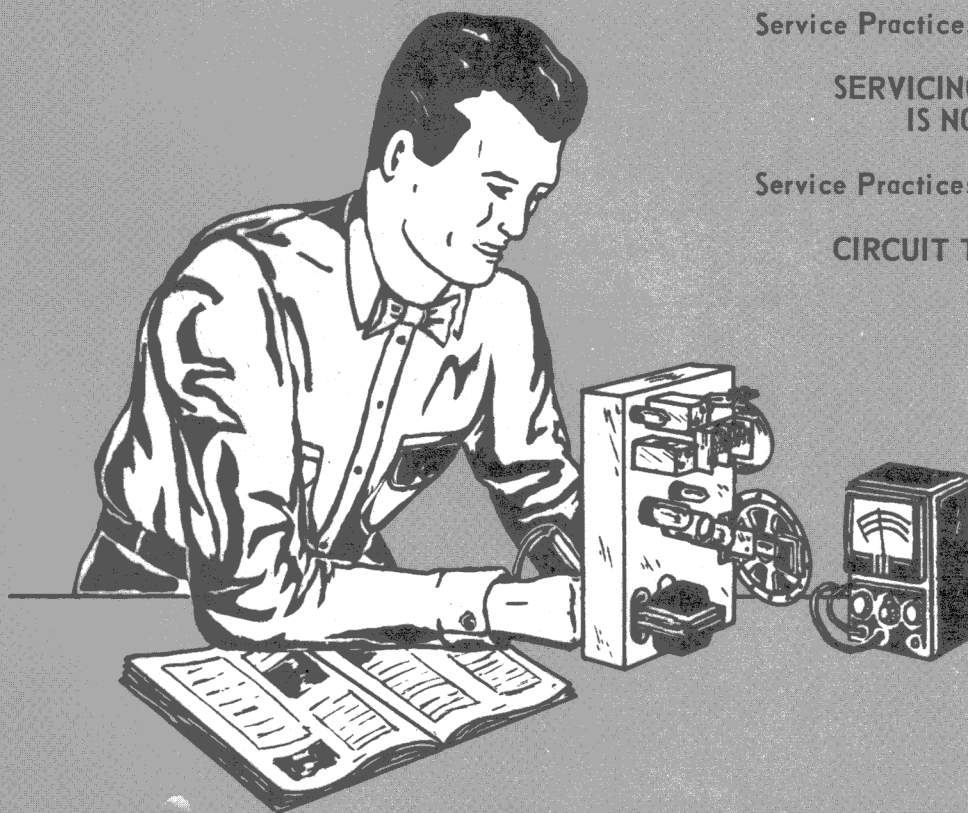


ELECTRONIC FUNDAMENTALS

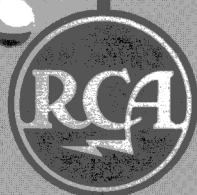


Service Practices 17:

SERVICING WHEN RECEIVER
IS NOT AT FAULT

Service Practices 18:

CIRCUIT TRACING



RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

New York,

N. Y.

ELECTRONIC FUNDAMENTALS

SERVICE PRACTICES 17

SERVICING WHEN RECEIVER IS NOT AT FAULT

- 17-1. Noisy Reception
- 17-2. Weak Signal and Noise
- 17-3. Fading
- 17-4. Poor Tone Quality
- 17-5. Interference
- 17-6. No Reception
- 17-7. Power Reception in
Auto-Radio Sets
- 17-8. Poor Reception in Battery
Portable Sets
- 17-9. What to Do When Radio
Receiver is Not at Fault



RCA INSTITUTES, INC.

**A SERVICE OF RADIO CORPORATION OF AMERICA
HOME STUDY SCHOOL**

350 West 4th Street, New York 14, N. Y.

Service Practices 17

INTRODUCTION

Doctors must know when a patient is sick and really has something wrong with him and know when there is nothing wrong with the patient. In many cases, the patient may not feel well due to an outside cause such as the weather, but may be in perfect health otherwise. The radio technician and TV repairman finds himself in a similar position. Being a radio or TV "doctor" he must know when a radio or TV set is "sick" and in need of repairs. But he must also know when *not* to look for trouble within the set, even though the received programs do not sound good.

The purpose of this lesson is to learn about complaints and faults that are not due to any defects within the sets but instead are due to outside causes.

These faults are found with all types of radios - home-type radios, portable radios, and automobile radios. Common complaints that may have outside causes are:

1. Noisy reception
2. Fading
3. Poor tone quality
4. Interference
5. No reception

The five complaints listed can be due to actual trouble within the receiver. However, this lesson will help you to know when something other than a defect in the receiver is causing them. We will begin with the standard broadcast radio set, operating from house current. Standard broadcast sets are called AM receivers. AM stands for amplitude modulation and it is one way of carrying sound on radio waves.

Standard broadcast radio stations use AM. Small kitchen radios, portable radios and automobile radios are usually AM receivers.

Other home-type radio sets are called FM receivers. FM stands for frequency modulation, which is a different way of carrying sound on radio waves. FM receivers are designed to pick up broadcasts from radio stations using frequency modulation. Some home-type radios are FM receivers. Console radios are often AM-FM combination receivers. Deluxe console sets may be able to pick up AM broadcast stations, FM broadcast stations, and, in addition, short-wave stations. (Short-wave stations usually use AM.)

Troubles that are found in one type of receiver may not be found in another type of receiver. Troubles that cause poor radio reception in AM receivers may not cause FM receivers to operate incorrectly. Outside interference, which is carried into a radio set on the power line, cannot trouble a battery portable radio; the portable is not plugged into the power line. Outside interference carried into an automobile radio on the automobile power line cannot reach a set operating from house-electric power, unless the interference is in the form of radio waves.

17-1. NOISY RECEPTION

Both noise produced by a radio itself and outside noise cause noisy reception in a radio. Outside noise adds to the noise produced by the radio itself. The wanted signal must be strong enough to overcome any noise signal from any source. Otherwise a set sounds noisy. Outside noise is strong at some locations; weak at others. A useful service hint to remember is this: Anything that can be done to strengthen the wanted signal at the *input* of a receiver will make all noise sound weaker.

What causes outside noise? Any quick change in the amount of electric current flowing in a circuit near a receiver or connected to it. Does this sound hard to understand? It is really simple. You throw a light switch on and you hear a click in your radio. The click is a form of what servicemen call noise. When you throw the switch there is a quick change in the amount of current in the light circuit. It goes from zero to whatever current the light takes in less than a second! AM sets respond to outside noise; FM sets do not.

There are many reasons why AM sets operate in a noisy manner, even though the radio receivers themselves are not at fault. The most common reasons are:

1. Hiss
2. Atmospheric conditions
3. Electrical machinery and equipment

All radio receivers make a noise that sounds like a hiss. Nothing can be done to prevent hiss, although good design keeps it low.

Usually, hiss is not loud enough to be noticed. The radio waves that carry speech and music are much stronger than the radio waves in the receiver that produce the hiss. However, when the wanted radio waves are also weak, the hiss becomes noticeable. It is always heard between stations where there is no wanted radio signal.

A radio receiver is said to be receiving static when atmospheric conditions cause noisy reception. Static electrical charges act between clouds, or between clouds and earth, just as electrical charges do between the plates of capacitors. When such a charge (voltage) reaches a certain large value, it discharges between clouds or between clouds and earth. This discharge results in a lightning flash, commonly seen during thunderstorms. This electrical discharge, as shown in Fig. 17-1, results in a quick change in current. Quick changes in current produce radio signals. Therefore, the quick change in current produced by lightning results in the transmission of noisy radio waves, as though the clouds were radio transmitting stations. These radio waves result in a crackling and crashing type of noise that is heard in all AM receivers within range of the

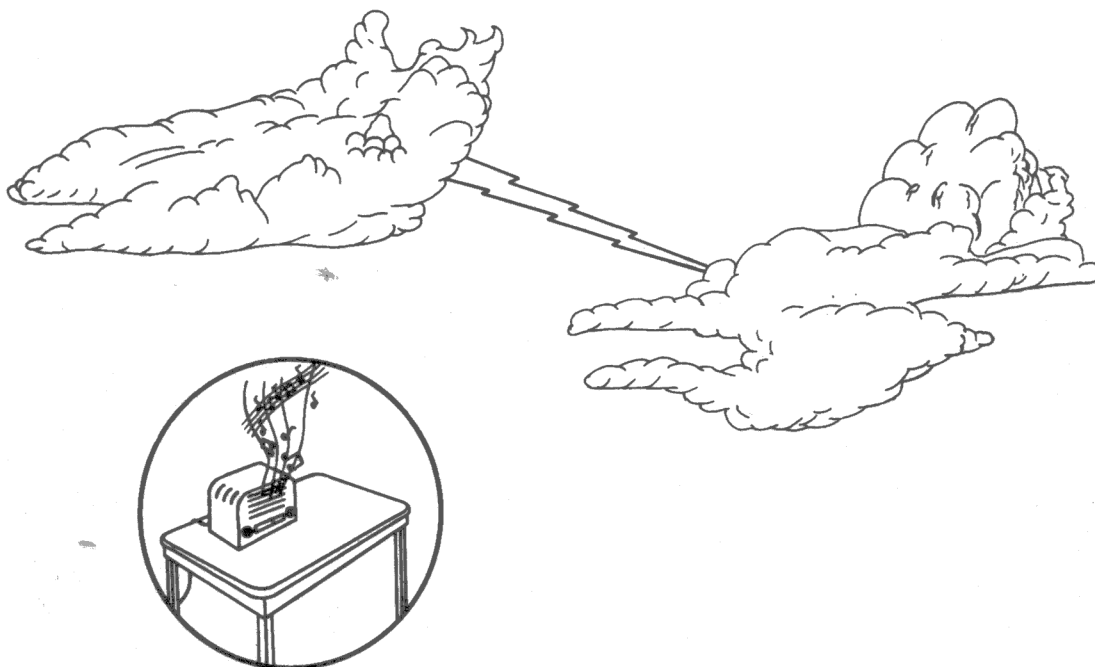
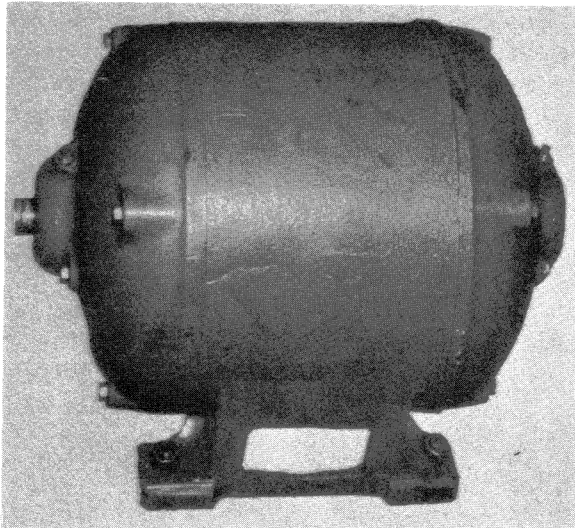
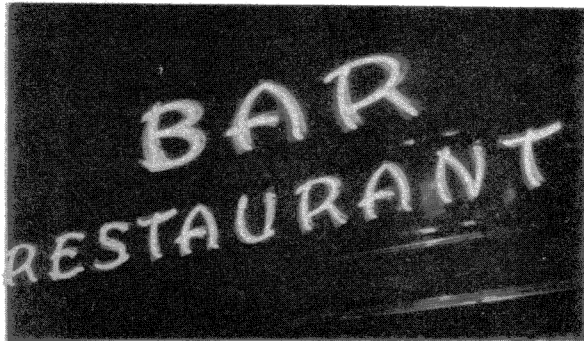


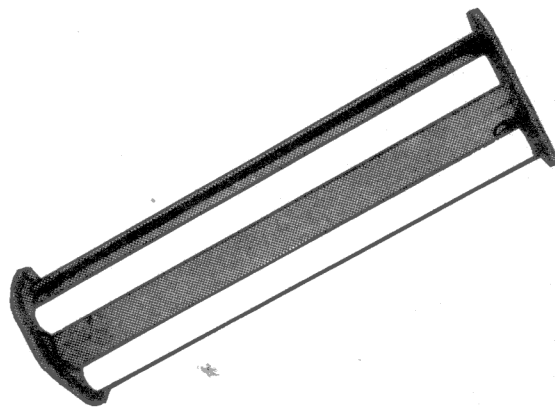
Fig. 17-1



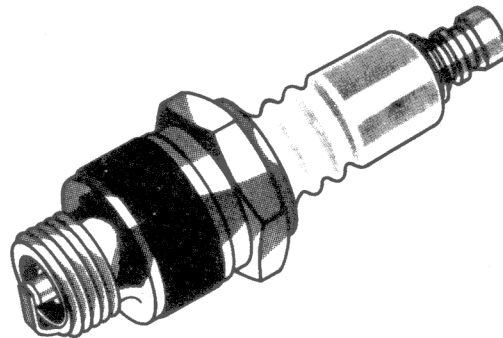
(a)



(b)



(c)



(d)

Fig. 17-2

electrical discharge. Sometimes this static noise is heard in radio sets even though an electrical storm is not in sight. The noisy reception in these cases may be due to static discharges from clouds over the horizon or an electrical storm in another county.

Static due to atmospheric conditions is most often received during the summer months. Sometimes static is received during snow storms in the winter. When static reception occurs, there is not much that can be done except to await the passing of the storm. Under these conditions, best reception is obtained with the tone control adjusted to the deep, or bass, position. When this is done, the static noise does not sound as sharp and does not grate on the ears.

A common cause of noisy reception is due to electrical machinery and equipment. Figures 17-2a, b, c, and d show four types of electrical equipment found in the same room,

house, or neighborhood where a radio receiver may be operating in a noisy manner.

Figure 17-2a shows an electrical motor, one cause of noisy reception. Motors used in vacuum cleaners, refrigerators, electric shavers, food mixers, etc., often cause noise to be heard in radio sets. The noise occurs only when the electrical equipment is in operation and consists of a steady grinding type of sound heard in the loudspeaker. The noise is often so loud and annoying that the radio set must be shut off until the motor stops running. These noises are due to a *sparking* condition within the motor itself. This sets up *impulses*. An impulse is a quick change in current. Here again, a quick change in current causes unwanted radio waves. Sparking electric equipment always makes impulses of current. Therefore, sparking electric equipment makes a really good radio transmitter. As a matter of fact, in the early days of radio, ships used radio transmitters

made on the spark-gap principle to transmit radio signals. These transmitters are no longer used because it is not easy to make the transmitted signals come in at one place on the receiver dial. Spark signals are heard no matter where the receiver dial is set.

Neon signs operating close by, as shown in Fig. 17-2b, are common causes of noisy reception in radio sets. This is especially true on damp and rainy days. Moisture gathers on the wires and insulators of a neon sign and sometimes causes electrical leakage to occur. This sets up impulses that are heard as noise in the set. The moisture on the wires and insulators sometimes causes the neon sign to flicker. When the weather clears and the moisture disappears, the sign stops flickering and the noise stops. Sometimes neon signs develop electrical leakage that causes noise in radio receivers, even though the weather is dry.

Figure 17-2c shows a typical fluorescent lighting fixture used in the home. Such fixtures often cause noise to be heard in radio receivers, especially when the fixture is close to the receiver or in the same room. Sometimes the noise is due to a flickering fluorescent lamp. In other cases, the lamp may be operating properly and still be causing the interference.

Automobiles cause spark-type interference in AM receivers. A spark plug is shown in Fig. 17-2d. This noise comes from the electric spark that explodes gasoline in the automobile engine. These sparks happen one after the other and close together. The separate clicks that such sparks cause in a radio sound like z-z-z-z-z-z. It is easy to know when radio noise is caused by an automobile. As the car speeds up, the noise speeds up, and when the motor stops, the noise stops. Such interference is common in receivers located in homes on busy streets. Car radios are designed with shields and filters to stop the interference. Home type AM receivers are not as well shielded and may be troubled by automobile-ignition interference.

17-2. WEAK SIGNAL AND NOISE

Suppose that we were to turn on a normally operating radio receiver, turn the tuning dial

to a position where no station can be heard, say 555 kc, and advance the volume control all the way to the right, to the full on position. Under these conditions, we might hear no noise, some noise, or much noise. If no noise other than a hiss is heard, there is no electrical interference and weak radio signals from low-powered or distant stations can be heard. But, if some noise is heard, the weak and far-distant signal will be drowned out by the noise, and only stronger stations or signals will sound clear. If much noise is heard at 555 kc, it may even drown out the strong signals from nearby stations.

Weak program signals are often due to:

1. Distance of transmitting station from radio receiver
2. Power of transmitting station
3. Wrong position of radio receiver in room
4. Wrong outdoor antenna installation
5. Wrong tuning of receiver

Some energy in a signal travels in a fairly straight line close to the ground. This part of the energy in the signal is called the ground wave, and is quite strong. This ground wave goes a certain distance and then weakens and finally dies out. Radio receivers that are able to pick up the ground wave of a station are said to be within the service area of that station.

Other parts of the energy of a broadcast signal go up into the atmosphere until they reach the *ionosphere*. The ionosphere is a layer of *ionized* (positively or negatively charged) gasses. The ionosphere acts like a mirror. It reflects the signal back to the earth, as shown in Fig. 17-3. The part of the

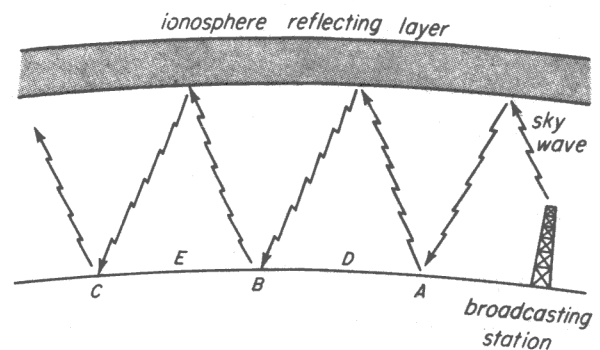


Fig. 17-3

signal energy that goes up to the ionosphere and is reflected back to earth is called the *sky wave*. The reflected sky wave bounces back to earth at a certain point, and the earth reflects it up to the ionosphere again, from where the sky wave is once more reflected to earth, and so forth. Each time that the signal is reflected, it becomes weaker. So, a radio receiver receiving a reflected signal far from the broadcast station is receiving a very weak signal. A receiver at a point between the points at which the reflected signal strikes the earth does not receive the sky wave at all. So, the signal received at point A in Fig. 17-3 is fairly strong, that received at B is weak, and that received at C is very weak; while at D and E, no signal is received at all. The area where no signal is heard is called the *skip area*.

Figure 17-4a shows a radio transmitting station far from the receiving set. The signals that travel from transmitter to receiver weaken as the distance increases. So, even though the station transmits with as much power as 50,000 watts, the signal is weak when it reaches the antenna of a far distant receiving set. And if the noise level is high at the receiving set, the weak signal may not be able to ride over it.

Figure 17-4b shows a transmitting station that is closer to the radio receiver than the one shown in Fig. 17-4a. But the transmitted power shown in Fig. 17-4b is only 250 watts. This also may result in a weak signal, which, as you have learned, may result in noisy operation of the radio set.

Weak signals are often due to the position of the radio receiver in the room. This is especially true when the radio set uses an indoor loop antenna rather than an outdoor antenna. Figure 17-4c shows how a radio receiver should be positioned in order to pick up the strongest signal. Placing the set in the correct position may improve the reception and reduce the noise because:

1. The loop antenna correctly faces *toward* the station
2. The loop antenna correctly faces *away* from electrical interference due to motors, fluorescent lighting, etc.

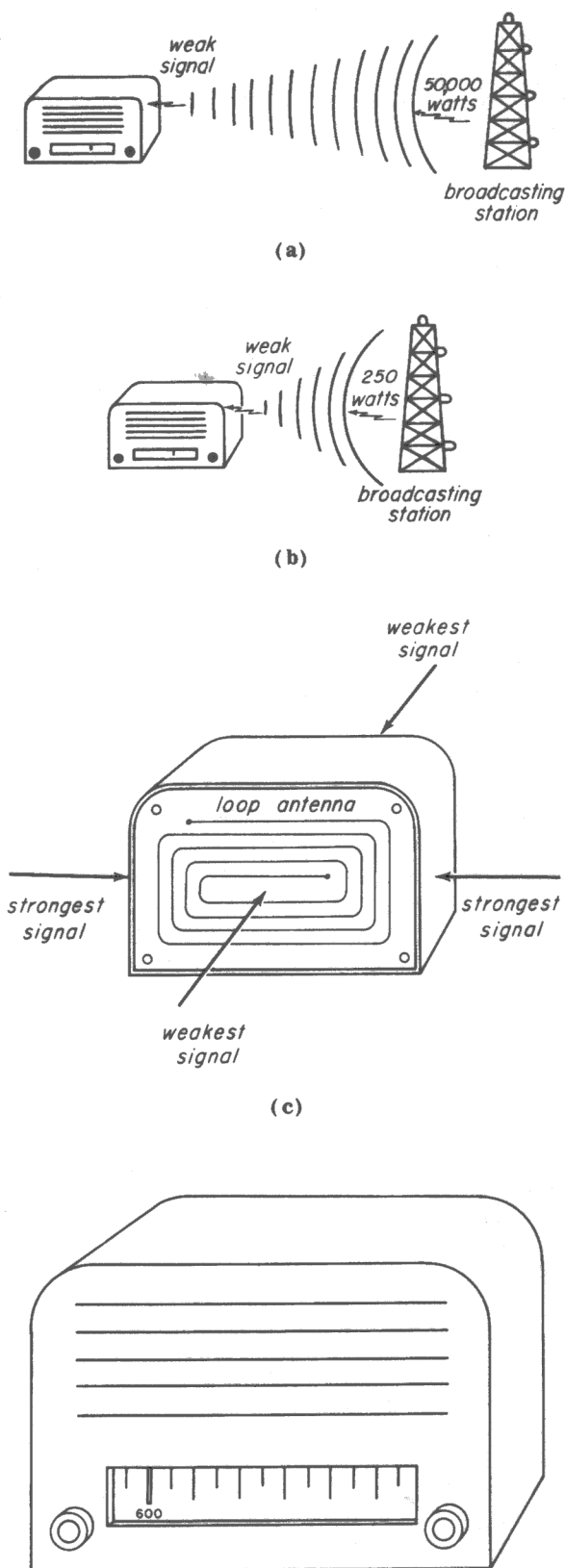


Fig. 17-4

However, sometimes the source of electrical noise and the desired station both face in the same direction. So the loop cannot be turned away from one and toward the other.

Very often, noise heard in radio sets is due to wrong adjustment of the tuning knob. Figure 17-4d shows the position of the dial pointer when the receiver is tuned to a 600-kc station. In this example, the 600-kc station can be properly tuned in at exactly 600 kc. However, the number printed on the dial does not always match up with the assigned frequency of the broadcasting station. So, always teach a radio set owner how to tune in the receiver by *ear* as well as the dial pointer. Teach him to listen for the station as the dial pointer nears the frequency marking of the station he wants to listen to. When he hears the station, he is to continue tuning as the station signal becomes louder and louder and, even when he thinks that it is as loud as it's going to be, to continue tuning past this point and wait until the signal starts to grow less strong. Then he should return to the point that sounded loudest and rock the tuner back and forth until he is sure that he knows where the signal *sounds* best and with the *least* noise. The point where the needle finally comes to rest may not match up exactly with the dial calibration of the station frequency; however the station will then be properly tuned in.

Reduced power-line voltage is another cause of low volume. Here the noise usually does not increase. In some locations, especially in country and suburban areas, the line voltage may fall to a value much lower than normal. Normal means 110 to 120 volts. In some cases, the voltage may drop to a value as low as 95 volts, due to a heavy load on the power line. The result is that the tubes in the radio receiver do not get their correct operating voltages, resulting in weakened volume. The volume is not weak all the time but only at the time of day when electric power is used most. This may be at night, when lights are turned on, or during the day when factories are using power, as shown in Fig. 17-5.

17-3. FADING

In a broadcasting studio, the announcer

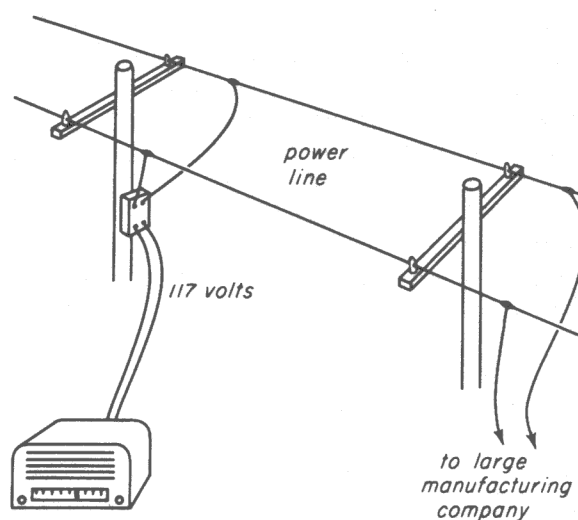


Fig. 17-5

may begin speaking with music in the background. As he talks, the engineer in the control room will cut down the volume of musical sound until the music disappears and only the announcer is heard. This operation is called *fading out* the music. When the message of the announcer has been given, the music is *faded in*, which means that the volume of musical sound is turned up again until you can hear it over your radio. *Fading*, as men in radio use it, means the decrease of sound or the increase of sound, little by little.

When applied to the operation of radio receivers, fading usually means a combination of fading in and fading out of the signal sound. Sometimes, of course, a program being received on the radio may get lower and lower in volume until it disappears, without anyone touching any of the receiver controls, and stay faded out. More often, however, the program may return all by itself. Whichever happens, the signal is fading. When the receiver is not at fault, the more common causes for fading are:

1. Ionospheric conditions, the time of day, and the season of year
2. Location of transmitting station with respect to receiver
3. Line-voltage variations

Fading very rarely if ever occurs in a normally operating radio set tuned to a local station. However, when the station is far

removed from the local area, fading very often occurs. For example, suppose that we were listening to an evening radio program coming from a station located 1000 miles away. As shown in Fig. 17-6, the signal arrives by means of the *sky* route. Within the service area of the station, the signal arrives at the receiver by the ground waves. (Of course, the ground route is not through the ground but near the ground.) The sky route is very uncertain because it depends on the ability of the ionosphere to reflect the signal. The ionosphere is not a perfect electrical reflecting mirror because it is a gas that is changing its density all the time. So, the signal at the receiver varies and results in fading.

This changing ionosphere depends a good deal upon the time of day and also upon the season of the year. For example, the ionosphere is a poor electrical reflecting mirror for radio waves during the day. So signals do not travel far during the daytime. After sundown the ionosphere may reflect these signals for hundreds or even thousands of miles.

The signal bounces back and forth between the ionosphere and earth. However, the signal strength varies and fading usually results.

Varying line voltage is another cause for fading in radio receivers. If the normal line voltage of 117 volts decreases to 95 volts due to a heavy load on the power line, the loudspeaker volume will drop due to the decreased operating voltages on the tubes. This can be the cause of a low-volume complaint if the line voltage remains low for long periods of the day or night. A customer may use his radio at the same time each day — the time of low line voltage. He would not know that the volume is high at other times. But, if varying line voltage is to cause *fading* sound, the change in volume must happen more often; that is, the line voltage must change more often. The customer will hear the volume increase and decrease. Probably he will call it *fading*.

The causes of *low volume* due to low line voltage — factories using power by day or

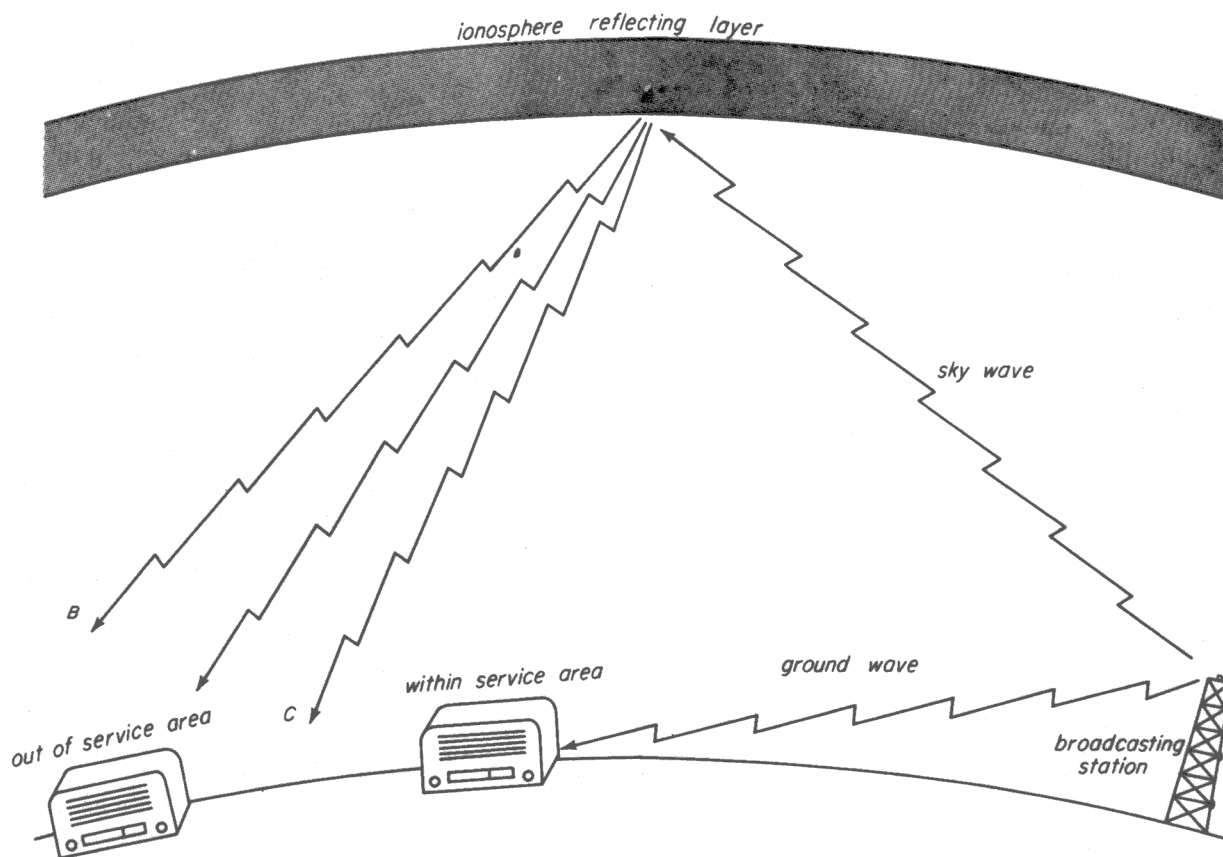


Fig. 17-6

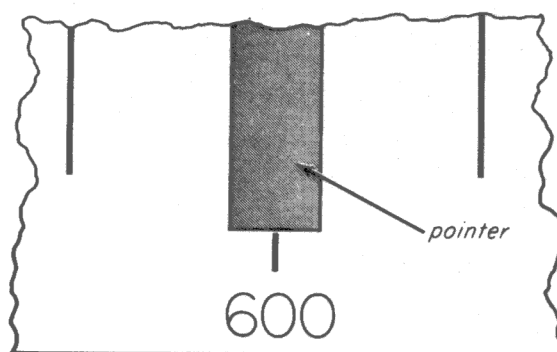
lights turned on at night — do not cause fading sound. Oil burners, refrigerators, deep freezers, electric irons, water-pump motors, etc., which go on and off by themselves rapidly, are the causes of fading due to varying line voltage. In such cases, line voltage varies only within a particular house, and not in all houses connected to the same power line.

17.4. POOR TONE QUALITY

A radio receiver may be in good electrical and mechanical condition but operate with poor tone quality. One cause for this is incorrect adjustment of the station-selector knob.

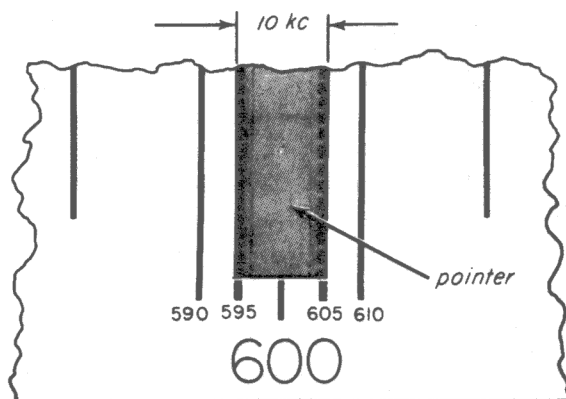
A radio broadcasting station does not transmit on a single electrical frequency — even though the dial pointer rests on one point, as in Fig. 17-7a. A station broadcasting on a frequency of 600 kc actually uses a band of frequencies from 595 kc to 605 kc. This band of frequencies is called the *bandwidth*. Each station operating on the standard broadcast band has a bandwidth of 10 kc. In much the same way, the receiver does not receive a standard broadcast signal on one spot on the dial. Instead, it receives a band of frequencies 10 kc wide. We call this the receiver's *pass band* — the band of frequencies that the receiver passes through its amplifiers for any setting of the dial pointer. In Fig. 17-7a, let the width of the dial pointer represent the receiver's 10-kc pass band. The center of the pointer represents the 600-kc point on the dial and is called the *carrier frequency* of the 600-kc station. The parts of the complete signal above and below the carrier frequency are called the *sidebands*. That below 600 kc is the *lower sideband*, and that above the carrier frequency is called the *upper sideband*.

When the dial pointer is set on 600 kc, as in Fig. 17-7b, the receiver is set to receive signals from 595 kc to 605 kc. It will receive the complete signal of a station operating on a frequency of 600 kc. If the pointer is set at 595 kc, as in Fig. 17-7c, the receiver passes only the frequencies between 595 kc and 600 kc that are being sent out by the 600-kc station. When this happens, we say that the receiver is getting



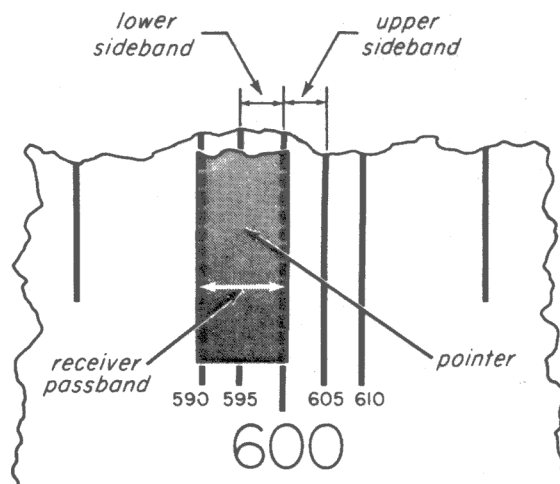
portion of dial scale

(a)



portion of dial scale.

(b)



portion of dial scale

(c)

Fig. 17-7

only the lower sideband. When the pointer is set above 600 kc, on 605 kc, the receiver passes only the upper sideband. When any part of either sideband is missing, certain tones that make up the complete broadcast signal are not passed by the receiver and so cannot come out of the loudspeaker.

Another cause for poor tone quality is *selective fading*. Earlier in this lesson, you learned that fading causes the signal to become first weaker and then louder. Selective fading is a *special* kind of fading. It makes certain frequencies of a transmitted signal fade more than other frequencies.

You have learned that there are three important portions of a transmitted radio wave. These are the carrier, upper sideband, and lower-sideband frequencies. Suppose that the ionosphere reflected the lower sideband and carrier frequencies in a strong manner but did not act as a good mirror for the upper sideband frequencies, as shown in Fig. 17-8.

The upper sideband would be weaker than the lower sideband (they should be equal in strength) when they arrived at the receiving antenna. Since the sidebands signals contain the program information, fading of this type is bound to cause distortion. Selective fading is often heard when a receiver is tuned to foreign broadcast stations. Persons talking sound as if they had their fingers clamped over their noses.

17-5. INTERFERENCE

When a radio receiver receives an unwanted signal, it interferes with the program coming from the desired station. The interfering signals you will now learn about are due to unwanted signals other than static and noise from electrical machinery. These are due to:

1. Incorrect tuning
2. Skip-distance effect

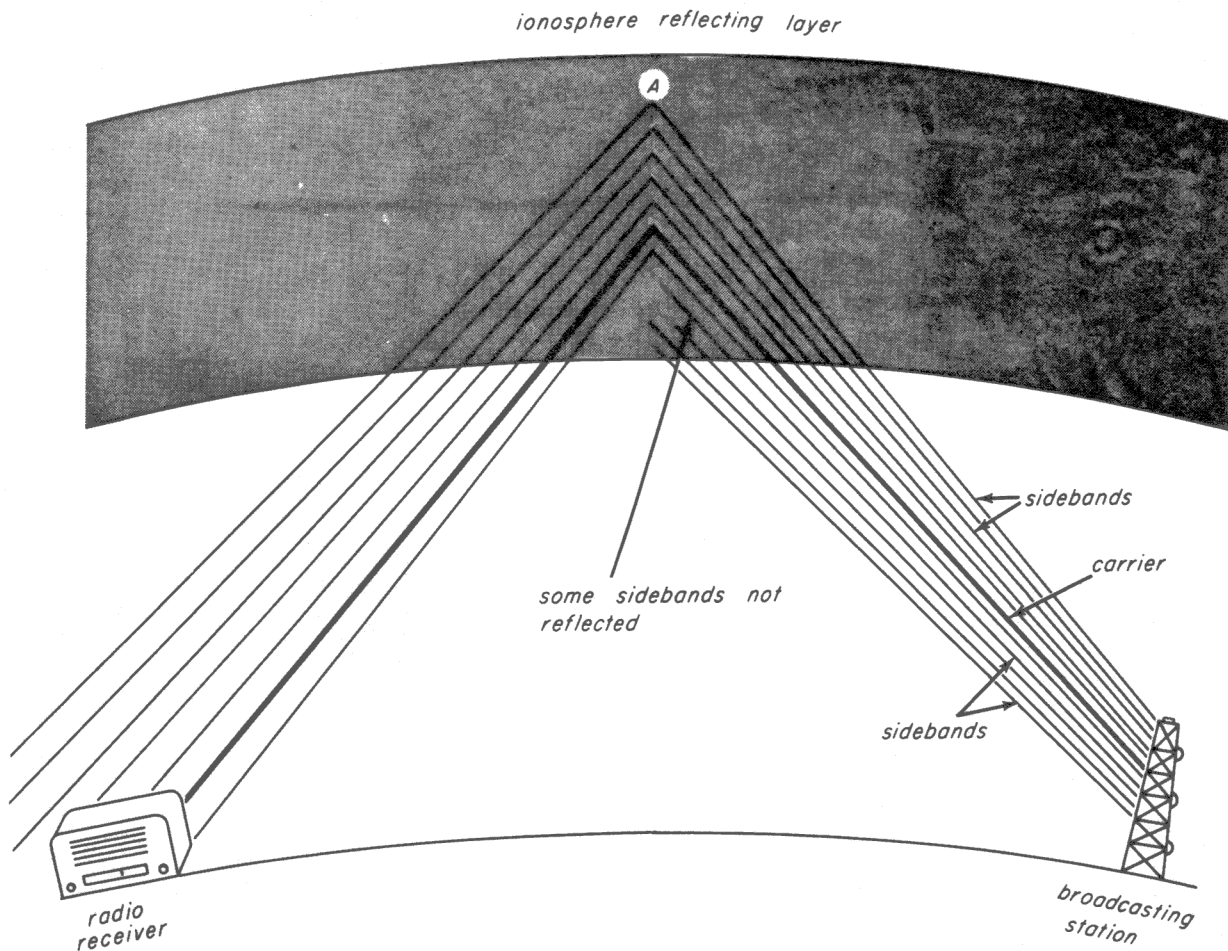


Fig. 17-8

3. Neighboring oscillator beat notes
4. Cross talk

Incorrect tuning often causes interference to occur because the dial is set to *two* stations instead of being correctly set to only one. The stations in the standard AM broadcast band are separated by a frequency of 10 kc. For example, a station having a carrier

frequency of 600 kc is 10 kc away from another station operating on a frequency of 610 kc. So, if the radio receiver were tuned so that *both* signals arrived at the receiving antenna, it would be possible to allow two programs to be heard in the loud speaker, both at the same time. Tuning to 605 kc between both stations as shown in Fig. 17-9a could cause this interference to occur. When the receiver is tuned more towards one station than the

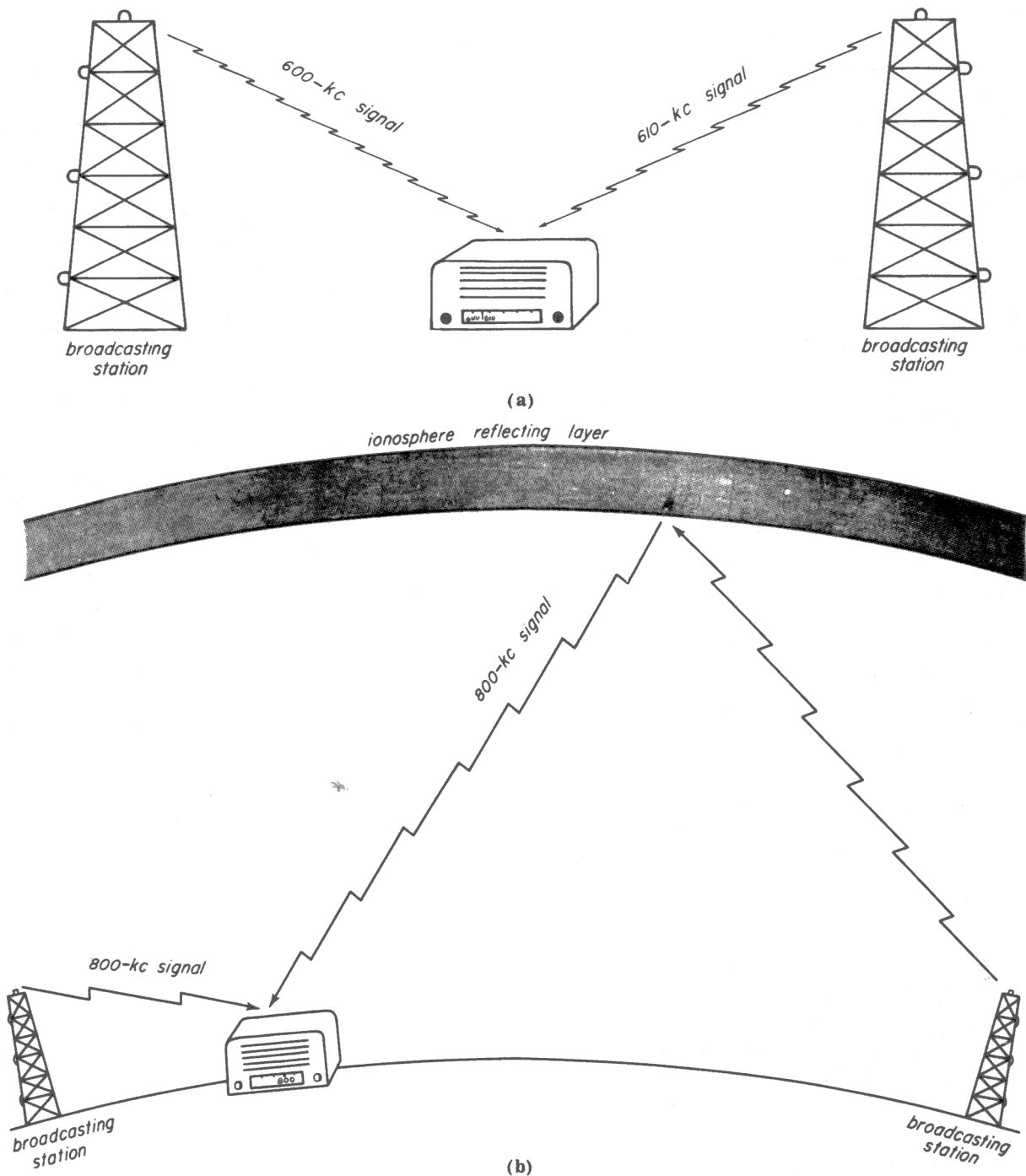


Fig. 17-9

other, only one station can be heard. However, part of the unwanted signal is in the receiver pass band. The two signals combine to produce a third signal, which is heard as a whistle. The whistle is called a *beat note*. We will discuss beat notes later in this course.

Interference can also occur due to *skip-distance* effect. Suppose we were to correctly tune-in a radio program coming from a station having an assigned carrier frequency of 800 kc. Suppose that an interfering radio program were heard on that same frequency coming from another station. According to law, two or more stations are allowed to broadcast radio programs on the same assigned carrier frequency, as long as they do not *normally* interfere with each other. So, many broadcasting stations in different parts of the country have the same carrier frequency and are broadcasting at the same time. Sometimes one station interferes with another distant station that is broadcasting on the same frequency due to the reflection of the ionosphere. Figure 17-9b shows how a far-distant 800-kc signal bounces off the ionosphere and causes interference in a radioreceiver tuned to another 800-kc station. This interference also produces a beat-note whistle. You hear the sound from each station and a whistle. It is not possible to tune out such interference.

A third type of interference that causes two stations to come in at once and produce a whistle is *cross talk*. This is similar to what happens during telephone communica-

tion when you can hear someone other than the person you are talking with. It happens when sound from another wire gets on your wire. In radio, it happens when sound from the carrier of one station gets on the carrier of another station. A more common name for radio crosstalk is *cross modulation*. Unlike interference due to skip distance reception, cross modulation happens with strong local stations. Cross modulation between radio stations and the 60-cycle signal on electric power lines cause radios to hum on some stations but not on others. FM receivers do not get this type of interference.

Interfering signals in radio sets are also often due to *oscillator beat notes*. An oscillator is a circuit in a radio receiver that makes a weak radio signal for use within the set. This type of interference produces an annoying whistle that is heard along with the desired radio program. The whistling beat note is caused by a neighboring radio receiver, which acts like a small radio transmitter. The oscillator of the neighboring receiver sends out a signal. If the neighboring set is tuned to a frequency very close to that of the radio station to which another set is tuned, an annoying beat whistle will be heard. The strength of the beat whistle sometimes can be reduced by moving a set to another part of the room so that the loop antenna faces away from the neighboring set. If an outdoor antenna is used, changing its position sometimes helps to reduce this type of interference. Figure 17-10 gives an example of two radio sets in adjoining rooms. Radio set A causes beat-note interference

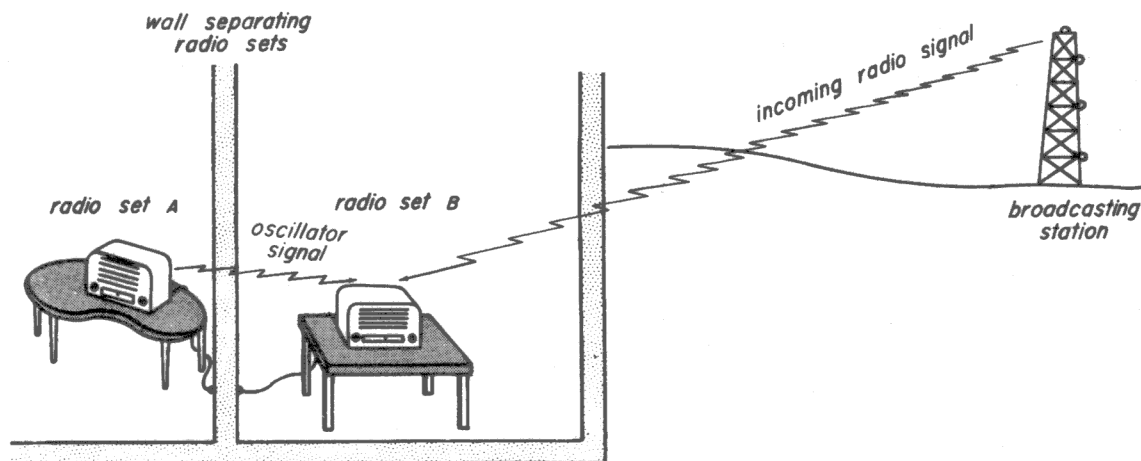


Fig. 17-10

in radio set *B*. The whistle will stop if either set is tuned to another station. You may hear a whistle come and go as your neighbor turns his dial looking for a program he likes.

Another type of beat note interference heard in radio receivers may be due to undesirable signals sent out by your own TV receiver or one belonging to a neighbor. The TV set may act as a transmitter, sending out a signal. The frequency of this signal in TV receivers is 15,750 cps. Unwanted harmonics of this frequency are also part of the signal. A harmonic is the signal multiplied by any number without a fraction or decimal (5 or 55 for example but not $5\frac{1}{2}$ or 55.3). The 50th harmonic of 15,750 cps is $15,750 \times 50 = 787,500$ cps. This is the same as 787.5 kc. If a receiver is tuned to an AM radio station broadcasting on 790 kc, beat notes will occur between the undesirable harmonic of the 787.5-kc signal transmitted by the TV receiver and the desired 790-kc signal. The beat combination between these signals is 790 minus 787.5, or 2.5 kc. So, a 2,500-cycle beat whistle will be heard in the radio receiver along with the program coming from the desired station. This type of interference causes whistles all along the radio dial at every spot where a harmonic of 15.75 kc is close to a station signal. Changing the position of the radio receiver in the room or trying another wall outlet (to eliminate the possibility that the unwanted signal is traveling along the power line) sometimes helps to reduce this type of interference. Changing the position of the outdoor radio receiving antenna, if one is used, sometimes reduces or eliminates this trouble. A filter plugged onto the radio power cord may also eliminate this type of noise. Such a filter can be obtained at radio and TV parts stores. A photograph of one type is shown in Fig. 17-11.

17-6. NO RECEPTION

Sometimes a radio receiver is brought to a repair shop by a set owner who complains that the set does not play when it is turned on in the home. However, when the set is turned on in the repair shop, it is found to operate normally. The most common rea-

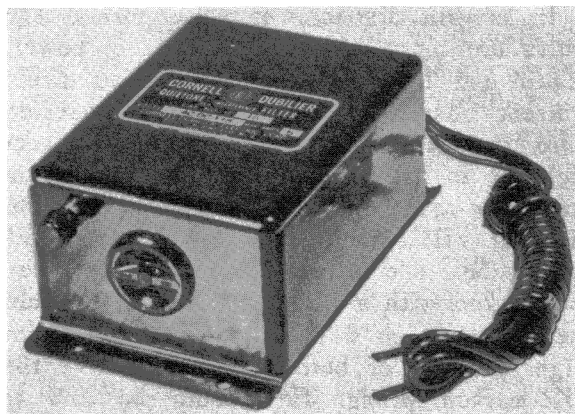


Fig. 17-11

sons for no radio reception when the set is turned on in the customer's home are:

1. Plug not connected, or poor wall-socket contact
2. Reversed-polarity connection to d-c wall socket outlet

When a serviceman tries to operate the radio receiver in the home, he may find that the trouble is due to the line plug being out of the socket. The plug may have been pulled out accidentally or during house cleaning. Poor electrical contact between the plug prongs and wall socket outlet can also cause the set to fail to work. Sometimes this can be corrected simply by bending the plug prongs with a pair of pliers so that they look as shown in Fig. 17-12a.

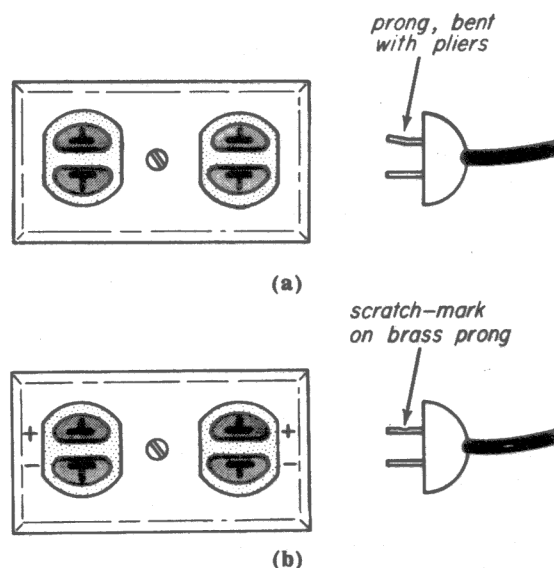


Fig. 17-12

In certain districts of some cities, 117 volts d.c. is used as the source of power. Radio and TV sets that operate from direct current must have their line plugs inserted into the electrical outlet so that correct polarity is obtained. If the line plug is inserted in reverse, as you know, the radio or TV set will fail to operate. Figure 17-12b shows how one brass prong of the plug can be marked with a file. The customer should be shown which wall-socket contact (left or right, or top or bottom) is to receive the file-marked prong. He should be told to check the position of the marked plug prong, if the radio or TV set fails to operate before calling the repair shop. Sometimes the plug is pulled out of the socket during cleaning and accidentally reinserted into the electrical wall outlet in reverse.

Blown fuses are a cause for radio sets failing to operate. This of course can be checked by simply plugging a lamp into the the same socket to make sure that electrical power is there.

17-7. POWER RECEPTION IN AUTO-RADIO SETS

Auto-radio receivers, like home-type radio sets, can operate with poor results even though the receiver and its installation are both in good condition. For example, static noises in an auto-radio receiver may be due to atmospheric conditions. Noise impulses due to electrical equipment and machinery can also result if the car is parked close to or is driven past a leaky power line, neon sign, etc. And, just as is the case with the home-type receiver, the strength or lack of strength of the transmitted signal can produce good or poor results. In other words, almost everything that has been mentioned about the home-type receiver that results in poor reception without receiver fault is also true of the auto-radio set.

In addition, poor reception in auto-radio sets can also result from the following:

1. Reception in tunnels and over bridges
2. Reception in mountainous areas

3. Reception on roads

In most cases, the receiver will not receive signals when the car is traveling through a tunnel. Radio signals do not penetrate the tunnel which is, therefore, a shield. Radio reception is usually found to vary on steel bridges; the signal first becomes weaker and then again stronger (fading). This is due to the change or variation in signal strength over certain portions of the bridge. The whip antenna picks up more signal in some places on the bridge than in others. Reception is usually noisier when the car is driving over a bridge than when it is off the bridge and back on the road.

In mountainous areas, auto-radio reception usually can be expected to be poor. This is due to a shielding effect. The hills and mountains act as giant shields and prevent the signal from reaching the whip antenna with the proper strength. This is especially true in a deep valley. In such a case, there may be no reception at all, or very noisy and weak reception with fading.

Best reception usually is obtained when the car is traveling along the open road in flat country. However, even here, programs can be expected to fade out or become noisy. As an automobile travels away from a tuned-in station, the signal gradually gets weaker. Soon, the noise level becomes stronger than the program. Then it becomes necessary to retune the set and select another station. In addition, poor reception in auto radios can be the result of conditions within the engine and electrical system of an automobile. A later lesson will deal with this.

17-8. POOR RECEPTION IN BATTERY PORTABLE SETS

When a portable receiver is operated in the home, either on batteries or from the house current, the reasons for poor reception due to outside causes are the same as already described for the home-type set. When the set is being operated from batteries on a train, or bus, or when it is carried by a walking person, poor reception can be expected often. For example, suppose that we were listening to a radio program while aboard a

moving train or bus. We could expect the signal to change strength and to be weak and noisy at times for the following reasons:

1. The steel or aluminum cars shield the loop antenna from the signals.
2. The loop antenna changes direction, first facing to, and then away from, the radio station as the train or bus goes around curves.
3. Electrical equipment in the train or bus (motors, etc.) produces noise impulses.

A loop antenna, used in portable sets, picks up signals best from only two directions; the whip antenna of a car radio picks up signals from all directions. That is why auto-radio reception is not affected as much when the car goes around a curve. When a battery portable is carried by a walking person, the fading is often due to the loop antenna first facing to and then away from the station as the direction of travel changes. As buildings, trees, and other objects are passed, they also help to change the strength of the received signal due to their shielding effect.

Battery-portable receivers sound better when played indoors than when played outdoors. When a set is operated in the home, the volume does not have to be loud because the walls reflect much of the sound back to our ears. But when played outdoors, most of the sound escapes into open space. So, the volume control must be turned up higher to overcome this. This causes the set to overload, which results in distortion and poorer tone quality.

17-9. WHAT TO DO WHEN RADIO RECEIVER IS NOT AT FAULT

Suppose that you repaired a radio receiver for a customer in your repair shop and tested it completely before the customer took it back home. You receive a phone call in the repair shop from the customer who says, "My radio receiver was repaired in your shop, but it is not playing right". You are sure that this complaint must be due to an outside cause and not due to the repair work that was

done because the receiver operated perfectly before it left the repair shop. How can you prove to the customer that the trouble is not in the receiver but instead is due to an outside cause and, more important, what can you do to improve the reception?

In most cases, a trip must be made to the customer's home. The radio receiver should be tested in his home to make sure that the trouble is not with the receiver. Of course, if trouble is found in the set, it should again be brought to the shop, and further repairs should be made. If no fault is found with the receiver itself, the next step is to determine the outside cause of trouble.

First, have the customer turn on the set and tune it in; see if the trouble is due to improper tuning. Next, check the reception to see if the complaint is due to noise from electrical equipment. If this type of noise is heard, such as from motors, neon signs, leaky power lines, etc., prove to the customer that it is not due to a fault within his set. This can be done in the following ways:

1. Bring your own a.c.-d.c. portable radio with you. Plug it into the same socket outlet. Tune in his favorite radio stations. The same noise interference will be heard on this other set. The receiver also may be used on battery while you walk around looking for interference. For example if noise is caused by a fan motor, it will be loudest when you are near the fan.

2. Try to arrange to have the customer listen to a neighbor's set; in most cases, the electrical noise will be just as bad all around that vicinity.

3. Tune in an auto-radio receiver, first driving the car as close as possible to the vicinity of the noisy home-radio set. Sometimes but not always, the same electrical noise will be heard on the auto-radio set with the same strength. But, remember, the home-radio receiver operates directly from the electrically noisier power lines; the auto-radio set operates from a storage battery.

You may wonder why, if electrical noise is occurring, the set owner did not complain about it *before* the radio receiver was brought

to the shop for repair? Sometimes, local noise interference due to a leaky power line, electric motor, neon sign, etc., starts *after* a radio set has been sent out for repair by the set owner. He does not know that this interference has developed in this neighborhood until the set has been returned. So, naturally he thinks that the radio receiver was not repaired properly. Remember, the set owner is not a trained radio technician. These things must be explained to him in a calm and sensible manner, and he should be told why they happen. It is possible to give additional service to the radio set owner in his home, so as to reduce or even entirely eliminate certain types of noise in radio sets due to electrical interference. Some things you can do are as follows:

1. Change the position of the radio so that the loop antenna will pick up more signal.
 2. Install a better antenna.
 3. Install a power-line filter.
 4. Move the set to another place.
 5. Point out faulty electric equipment and appliances so the customer may have repairs made.
 6. If it is not practicable to eliminate the noise, instruct the customer to try to tune in the same program on FM if he owns an FM receiver. In many cases, the same program will be playing on FM.
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